

TYCO 17714 (20958-1007)  
PATENT

## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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Applicant: George Jyh-Shann Chou :  
Serial No.: 10/073,488 : Art Unit: 1742  
Filed: February 11, 2002 : Examiner: Wyszomierski, George P.  
For: METHOD AND APPARATUS :  
FOR INDUCTION HEAT :  
TREATING ELECTRICAL :  
CONTACTS :

## DECLARATION OF PRIOR INVENTION

(37 C.F.R. § 1.131)

Hon. Assistant Commissioner for Patents  
Washington, D.C. 20231

George Jyh-Shann Chou, whose address is 5365 Joshua Drive, Mechanicsburg,  
Pennsylvania 17050, declares as follows:

1. This declaration is to establish conception of the invention claimed in the above-referenced application at a date prior to December 21, 2001.
2. I have reviewed and understand the patent application referenced in the caption above (hereafter "Subject Application"), including the specification, abstract, drawings and claims therefor.
3. I have reviewed United States Patent Application Publication No. 2003/0115749 titled "Inductive Heating of Microelectronic Components" filed on December 21, 2001 and published June 26, 2003, which, on information and belief, is being relied on in at least one rejection of the claims of the Subject Application (hereafter "Antedated Reference").

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4. I am a co-inventor with Bogdan Octav Ciocirlan of the invention(s) recited in the claims of the Subject Application (hereafter "Claimed Invention").
5. The Claimed Invention of the Subject Application was conceived by my co-inventor and me before December 21, 2001 which is the filing date of the Antedated Reference.
6. As evidence that the Claimed Invention of the Subject Application was conceived before the filing date of the Antedated Reference, attached is a true and accurate copy of a preliminary invention disclosure (PID number 2001153) (hereafter "PID 2001153") that was prepared in connection with the Subject Application (see Attachment A).
7. PID 2001153 is dated June 28, 2001 and is entitled "Apparatus for Heat Treating of Micro Contact Components" and includes one cover page, two pages of text and three pages of drawings attached thereto describing and illustrating the invention that was conceived.
8. Figure 1 of the drawings attached to the PID 2001153 illustrates a cross sectional view of a contact with property gradient values in terms of Vicker micro hardness numbers along the micro contact after induction heating.
9. Figure 2 of the drawings attached to the PID 2001153 illustrates a comparison of stress relaxation data of an "as plated" contact, an "oven heated" contact and a contact after heat treatment in accordance with the Claimed Invention.
10. Figure 3 of the drawings attached to the PID 2001153 illustrates a sketch of an apparatus for heat treating micro contacts in accordance with the Claimed Invention.
11. Figures 1-3 were prepared on or before the date of the PID 2001153 of June 28, 2001.
12. As indicated in the PID 2001153, at least one working model or prototype utilizing the Claimed Invention was constructed on or about February 8, 2001.

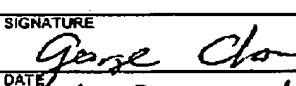
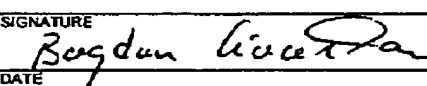
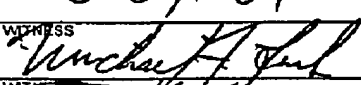

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13. The working model or prototype of the invention included the features shown in Figure 1 and the stress relaxation characteristics shown in graph C of Figure 2.

14. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on Information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

George Chou  
George Jyh-Shann Chou

6/20/06  
(Date)

TWC 3 (12/95)		<b>PRELIMINARY INVENTION DISCLOSURE</b>		The Whitaker Corporation (MS 324-001) 4550 New Linden Road, Suite 450 Wilmington, DE 19808	
DESCRIPTIVE TITLE OF INVENTION <b>Apparatus for Heat Treating of Micro Contact Components</b>				DATE <b>28 Jun 01</b>	
WHAT IS THE PROBLEM WITH THE STATE OF THE ART, OR PRIOR ART TECHNOLOGY? WHAT IS THE PURPOSE OF THE INVENTION? Conventional heat treating in the oven is a very time consuming process and imposes some limitations in using low temperature resistant materials as micro contact component's substates. The invention provides ways to reduce the heat treatment time and lifts the limitations encountered in the conventional heat treatment (see attachment).					
WHAT ARE THE NEW FEATURES OF THE INVENTION WHICH OVERCOME THIS PROBLEM? Same as above.					
ON SEPARATE DRAWINGS OR SKETCHES, DESCRIBE THE FEATURES OF THE INVENTION AND HOW THEY WORK. ARE THESE ENCLOSED? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO					
IDENTIFY THE CLOSEST PRIOR ART TECHNOLOGY, IF ANY, OF WHICH YOU ARE AWARE. PROVIDE COPIES IF AVAILABLE. N/A					
ENTER THE DATE OF THE FIRST WRITTEN DESCRIPTION OR THE FIRST DATED SKETCH OF INVENTION AND ATTACH COPIES.				29 Jan 01	
ENTER THE DATE A WORKING MODEL, DEVICE, OR PROCESS WAS OR WILL BE COMPLETED.				08 Feb 01	
GIVE A BRIEF DESCRIPTION OF CIRCUMSTANCES OF INITIAL DISCLOSURE OUTSIDE AMP COMPANIES. Concept was delivered to FormFactor Inc. people (covered under CDA) in a meeting on May 10, 2000 (see attached).					
ARE LATEST DRAWINGS ENCLOSED? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO ARE THEY CAD? <input type="checkbox"/> YES <input type="checkbox"/> NO					
IF CAD, WHO SHOULD BE CONTACTED TO RETRIEVE CAD FILES?					
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DATE <b>6-29-01</b>		DATE <b>06-29-01</b>		DATE	
WITNESS 		WITNESS		WITNESS	
WITNESS 		WITNESS		WITNESS	
DIVISION MGR NAME & PHONE <b>Richard J. Perko 717-985-2245</b>		DIVISION MGR NAME & PHONE <b>Richard J. Perko 717-985-2245</b>		DIVISION MGR NAME & PHONE	
— FOR THE WHITAKER CORPORATION ONLY —					
		JUL 09 2001		PID NO. <b>2001153</b>	
MSB: _____				ATTORNEY <b>Michael J. Aronoff</b> PHONE: (302) 503-261-599	

## ATTACHMENT TO PID: APPARATUS FOR HEAT TREATING OF MICRO CONTACT COMPONENTS

Electroplating of metallic materials is one step in the fabrication process of micro contact components. Typically, a micro contact component is composed of metallic micro contacts and a substrate that is made of either polymeric or ceramic material. However, high residual stresses due to plating and the as-plated microstructure of the contact body result in inferior stress-relaxation properties. Thus, a heat treatment process is usually considered to improve the stress-relaxation properties of the micro contacts after electroplating. The improvement consists of relieving of the residual stresses and changing the microstructure from as-plated to equi-axis grains by recrystallization. It is believed that the best way to achieve the above changes is to heat treat the metallic micro contacts at high temperatures. Due to the temperature limitations of the micro contact substrate, in order to avoid any damage, the components can be exposed only to a "low temperature treatment" for a long time in an isothermal oven. However, the polymeric materials that can survive the "low temperature treatment" are still considered as high temperature resistant polymeric materials. The choices of these materials are limited and their cost is high.

The invention proposed herein is an apparatus based on the induction heating principle designed to heat treat the metallic micro contacts at high temperatures. During the induction heat treating, the metallic contacts are heated up to high temperatures as an effect of the induced eddy current. The polymeric or ceramic substrate is immune to the induction heating and the substrate is heated up only by the heat transferred from the micro contacts. The substrate temperature is much lower than the temperature limits of the substrate materials. Thus, the limitation imposed by the conventional oven heat treatment to consider only high temperature resistant materials as substrates is lifted and, thus, both low and high temperature resistant materials can be used. Another feature of the proposed apparatus is the reduction of the heat treatment time required to obtain the desired results in terms of stress relaxation properties. This is due to the exposure of the micro contacts at high temperature. Also, a desired microstructure gradient-like property along micro contact body can be obtained (Figure 1). To emphasize the performances of the heat treating apparatus, a comparison of the stress relaxation test data of micro contacts for three conditions, namely as-plated, heat-treated in the conventional oven and heat-treated by using the proposed apparatus is shown in Figures 2(a), (b), and (c), respectively. Comparable and better stress relaxation properties were found for the inductively heat-treated micro contacts compared to the heat-treated in the oven.

The heat treating apparatus is composed of an induction heating work cell, a component holding stage, alignment fixture and stage motion control and mechanisms. The motion of the stage relative to the coil of the induction heating work cell can be programmed to fit any profile, such as constant speed, linear speed, index, and/or combination, etc. A sketch of the apparatus is shown in Figure 3. The micro contact components are placed on the Z-adjustable stage (1) and passed through the time varying magnetic field generated and shaped by the coil (2). The adjustable stage (1) is mounted on the XY linear stepper motor (3). The coil (2) is aligned with the adjustable stage (1) by the alignment bridge (4). The coil (2) is mounted to the electrical terminals of the 1kW power supply (5). The frequency of the magnetic field that is generated by the coil (2) is in the range of 10-15 MHz required to effectively provide current penetration

needed for heating the micro contact work piece (the micro contact size is, for example, 0.1 mm in diameter and 1.0 mm in length).

To control the temperature field within the micro contact body, the following process variables were considered:

- Magnetic field intensity, controlled by the power supply.
- Magnetic field frequency, adjusted according to the dimensions of the micro contact.
- Standoff distance (distance between coil and micro contact), controlled by the Z-adjustable stage (1).
- Processing time, controlled by the power supply (5) and XY linear stepper motor (3).
- Convective cooling
- Part geometry

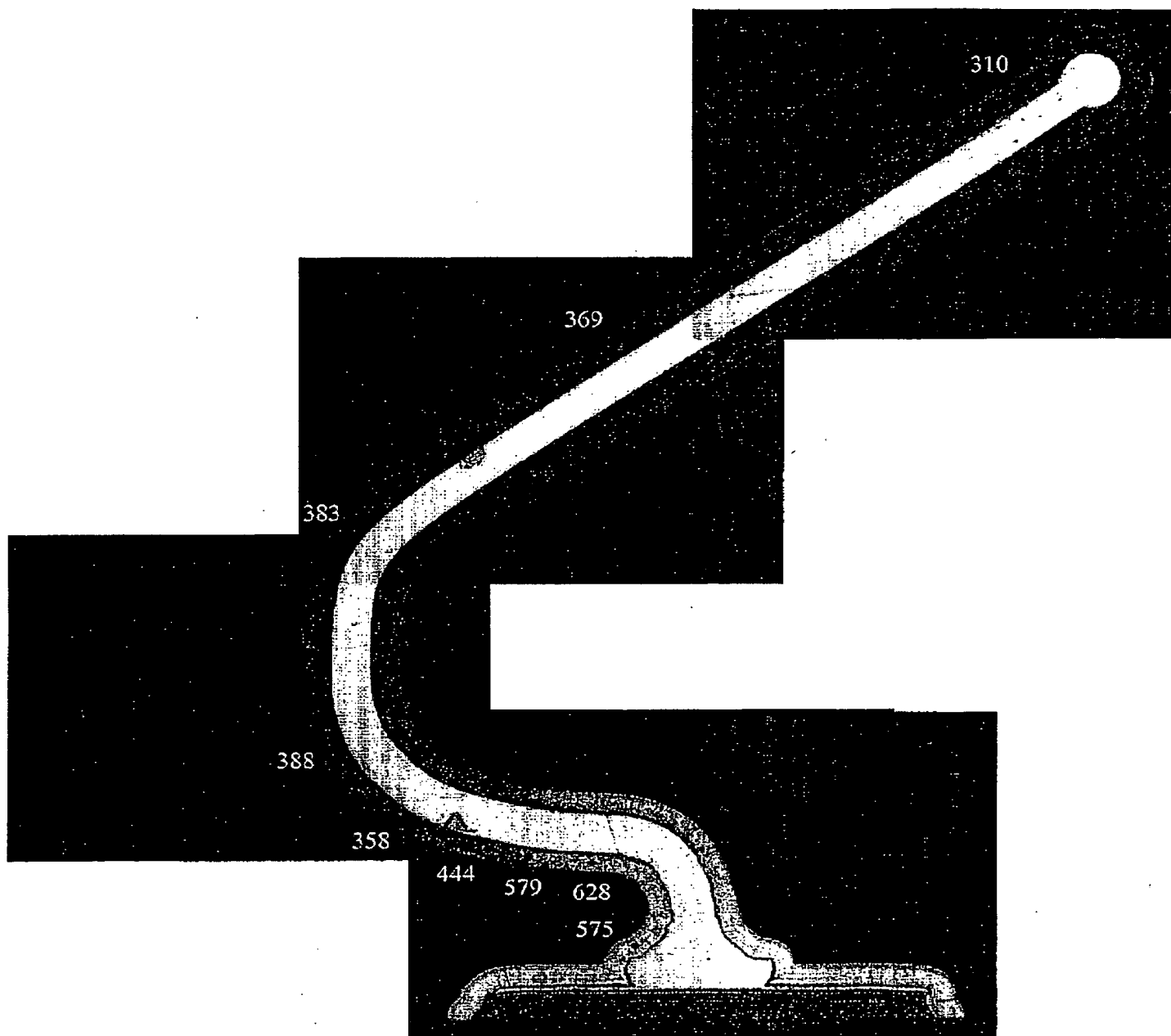


Figure 1. Property gradient in terms of Vicker microhardness number along inductively heat-treated micro contact.

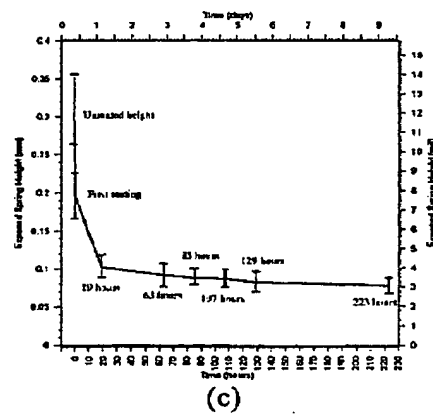
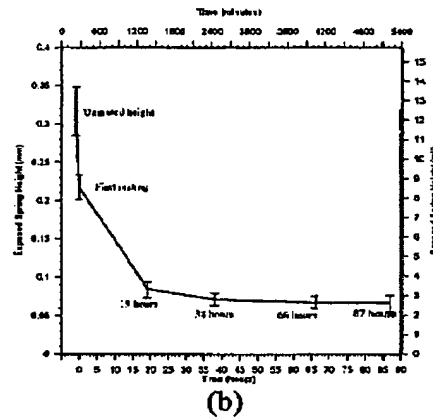
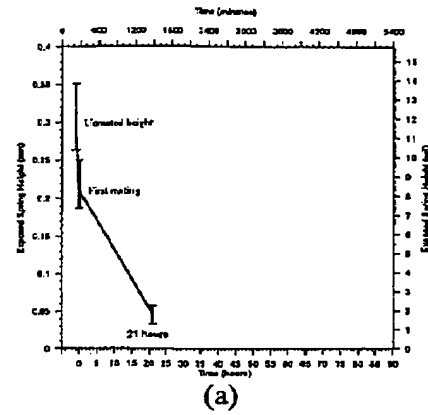


Figure 2. Comparison of stress relaxation data of (a) as-plated, (b) oven heat-treated, and (c) proposed apparatus heat-treated components.

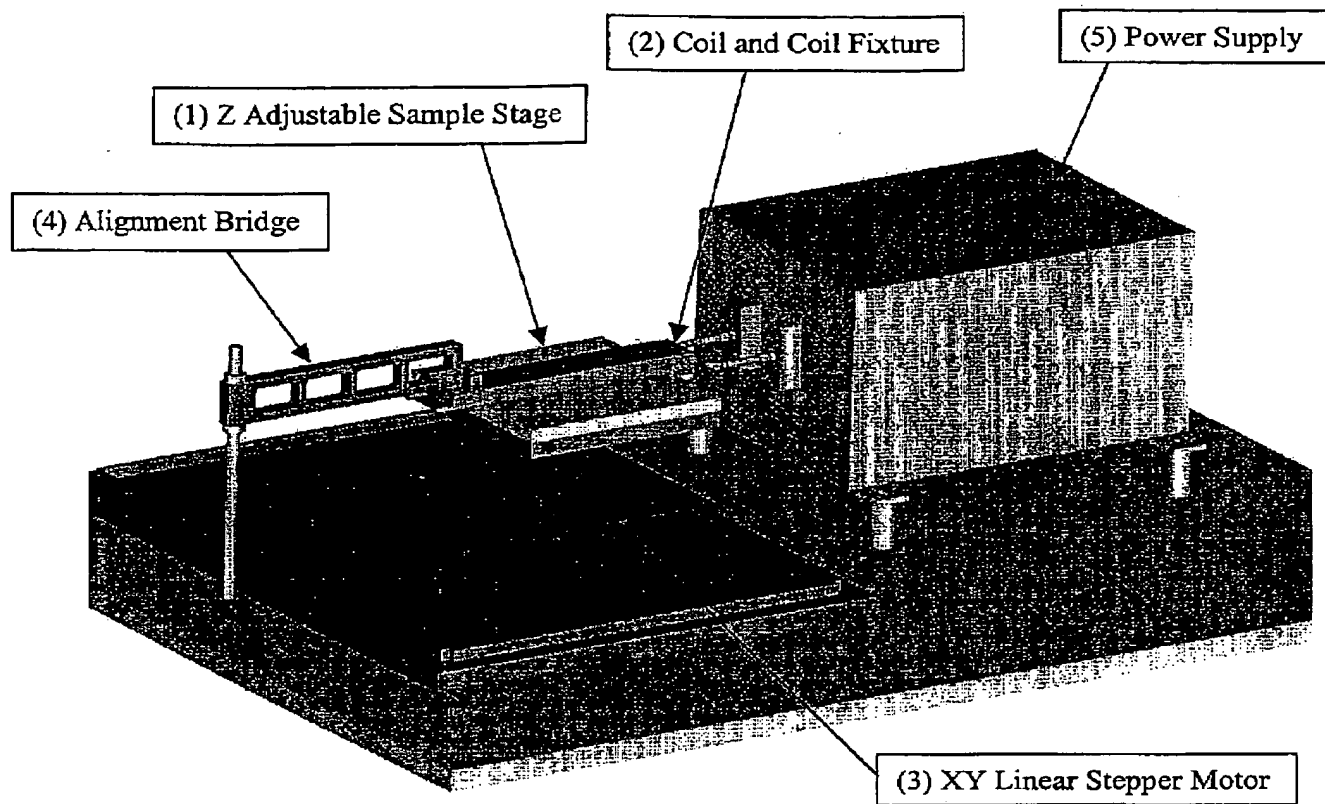


Figure 3. Sketch of the apparatus for heat treating of micro contact components.

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